


# NUCLEONICA: Dosimetry & Shielding

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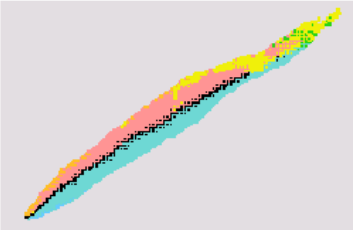
# Nuclear science applications...



## ... web driven nuclear science


Applications My Preferences Help


### > Nuclide Explorer



» Actual Chart: Karlsruhe

### > Search Nucleonica Documentation

 Nuclear Data Retrieval



### > Application Centre

- » Mass Activity Calculator
- » Decay Engine
- » **Dosimetry & Shielding**
- » Range & Stopping Power
- » webKORIGEN
- » Universal Nuclide Chart
- » Transport & Packaging
- » Nuclide mixtures
- » Nucleonica Scripting
- » Library creation for 3rd party software
- » Radiological Dispersion Module
- » Extended Graph Module

### > Data Centre

- » Physical Constants
- » Nuclide Datasheets
- » Nuclide Derived Data
- » Average Cross Sections
- » Radiations
- » Prompt Gamma
- » Fission Yields

### > Knowledge Centre






- » Nuclear News
- » Reading room
- » Useful Weblinks
- » Ask An Expert
- » Element Information
- » Conference Calendar

### Welcome, Joe






[Edit Preferences](#) [Administration](#)

MyCommunity Portal



### > My Last Nuclides

-  90 Th232
-  90 Th231
-  94 Pu239
-  92 U235
-  25 Mn52






### > My Nuclide Mixtures

-  Pu238+daughter (100g @50y)
-  Natural Uranium
-  Cs137 + Ba137m
-  U232+Co60
-  Transuranics in 1 ton Spent Fuel (4.2% enriched, 50GWd/t, 6 years cooling)

### > My Sources


-  Pu239 1 g
-  natu

### > My Messages

-  Thanks!
-  About my group and information
-  Photo Change
-  Open call for JRC Traineeships at the Institute for Transuranium Elements
-  NAMLS-9 International Conference on Nuclear Analytical Methods in the Life Sciences


» View

### > User Alerts

-  Task completed (DecayEngine: Uranium 238)

» View

# Dosimetry & Shielding:

 ... web driven nuclear science

Applications My Preferences Print **Help**


Co60

10.47 m 5.27 y

## Dosimetry and Shielding

### 27 Cobalt

Current Chart: Karlsruhe

Element: Co Mass: 60  Nuclide Mixtures Selector

Dosimetry and Shielding

Dose rate/Thickness graph Options

Source strength


Activity(Bq) 1E+06

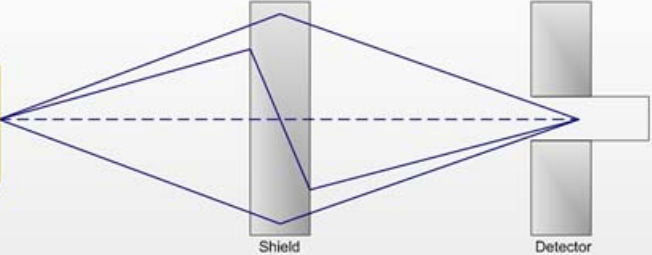
Shielding material


Pb 1 cm

Dose rate ( $\mu\text{Sv/h}$ )

???

  
Source

  
Shield

  
Detector

Source/detector distance (cm)

100

 [wiki]

Magill my talk preferences my watchlist my contributions

help discussion edit history delete move

## Help:Dosimetry & Shielding

In this section the formalism for dosimetry and shielding calculations is developed. In the following sections a brief description of the interaction of radiation with matter is given together with the physical basis of radiological dosimetry and shielding.

Contents [hide]

1 Biological Effects of Ionising Radiation

2 Absorbed Dose

2.1 Quality or Weighting Factor

2.2 Equivalent Dose

2.3 Effective Dose

2.4 Committed Effective Dose,  $E(r)$

2.5 Collective Effective Dose

2.6 Radiotoxicity and Annual Limits of Intake (ALI)

2.7 Radiation Hormesis and the Linear Non-Threshold (LNT) Model

3 Attenuation of Gamma Radiation

4 Absorption of Gamma Radiation

5 Calculation of the Equivalent Dose Rate

6 Absorption in Tissue

6.1 Data for Tissue

7 Attenuation in Shield Materials

7.1 Lead

7.2 Concrete

7.3 Iron

7.4 Tin

7.5 Tungsten

7.6 Uranium

7.7 Water

7.8 Aluminum

7.9 Air

7.10 Tissue

8 Build-up Factors (B) for Shield Materials

navigation

- Main Page
- Community portal
- Current events
- Recent changes
- Random page
- Help
- Glossary

search

Go Search

toolbox

- What links here
- Related changes
- Upload file
- Special pages
- Printable version
- Permanent link

# Dosimetry & Shielding:

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Applications My Preferences Print Help

**Co60**  
10.47 m 5.27 y

## Dosimetry and Shielding

27 Cobalt

Current Chart: Karlsruhe

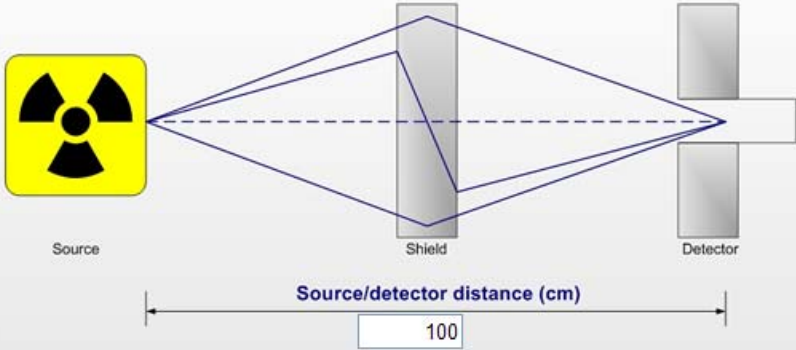
Element: Co Mass: 60 Nuclide Mixtures Selector

Dosimetry and Shielding Dose rate/Thickness graph **Options**

**Source strength**  
Activity(Bq) 1E+06

**Shielding material**  
Pb 1 cm

**Dose rate ( $\mu\text{Sv/h}$ )**  
???



Source/detector distance (cm)  
100

Start Reset

Element: Co Mass: 60 Nuclide Mixtures Selector

Dosimetry and Shielding Dose rate/Thickness graph **Options**

**Dosimetry and Shielding Settings**

Energy range option:  
☐ Only Gamma ☐ Only X-rays ☒ Gamma and X-rays

☒ Threshold set

Threshold energy (keV): 15

Result Detail option: ☐ Show Nuclides

Mode of operation option:  
☒ Gamma Dose Rate  
☐ Shield Thickness  
☐ Source Strength

# Dosimetry & Shielding:

Mode: shield thickness

Mode: source strength

Co60  
10.47 m 5.27 y

**Dosimetry and Shielding**  
27 Cobalt

Current Chart: Karlsruhe

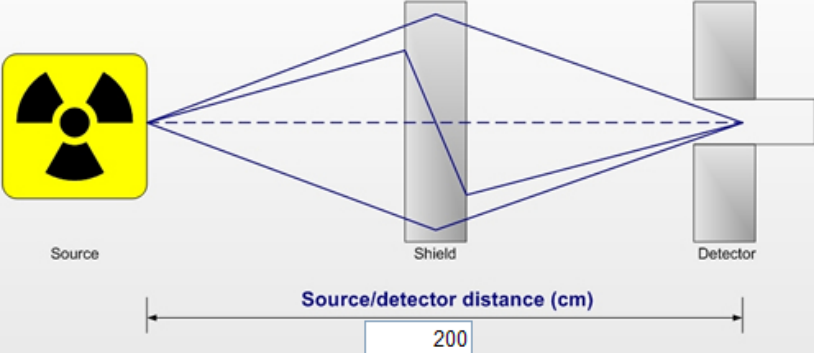
Element: Mass:  
Co 60 Nuclide Mixtures Selector

Dosimetry and Shielding Dose rate/Thickness graph Options

Source strength  
Activity(Bq) 100E+06

Shielding material  
Pb ??? cm

Dose rate (μSv/h)  
2



Source Shield Detector

Source/detector distance (cm)  
200

Start Reset

Co60  
10.47 m 5.27 y

**Dosimetry and Shielding**  
27 Cobalt

Current Chart: Karlsruhe

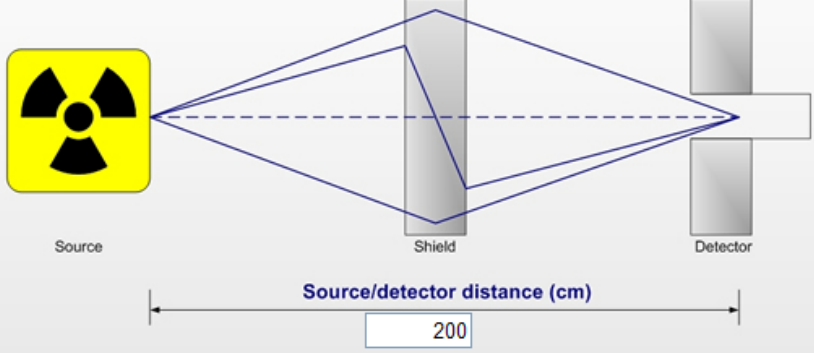
Element: Mass:  
Co 60 Nuclide Mixtures Selector

Dosimetry and Shielding Dose rate/Thickness graph Options

Source strength  
Activity(Bq) ???

Shielding material  
Pb cm

Dose rate (μSv/h)



Source Shield Detector

Source/detector distance (cm)  
200

Start Reset

# Exercises! Dosimetry & Shielding

## Mode: gamma dose rate

- What is the dose rate from a 100 MBq source of Co-60 at 2m distance without and with 5 cm lead shielding?

## Mode: shield thickness

- What thickness of lead is required to reduce the dose rate to 2  $\mu\text{Sv/h}$  at a distance of 2 m from the source?

## Mode: source strength

- A dose rate of 5  $\mu\text{Sv/h}$  is measured behind a 6 cm lead shield. It is known that the source is Co-60 and that the source detector distance is 2m. What is the activity of this source?

# Exercises! Dosimetry & Shielding

## Mode: gamma dose rate

- What is the dose rate from a 100 MBq source of Co-60 at 2m distance without and with 5 cm lead shielding? (ans. 8.4  $\mu\text{Sv/h}$ , 0.84  $\mu\text{Sv/h}$ )

## Mode: shield thickness

- What thickness of lead is required to reduce the dose rate to 2  $\mu\text{Sv/h}$  at a distance of 2 m from the source? (ans. 3.46 cm Pb)

## Mode: source strength

- A dose rate of 5  $\mu\text{Sv/h}$  is measured behind a 6 cm lead shield. It is known that the source is Co-60 and that the source detector distance is 2m. What is the activity of this source? (ans. 1 GBq)

Thanks!



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